

Robust Six-Axis Force and Torque Transducer, Phase I

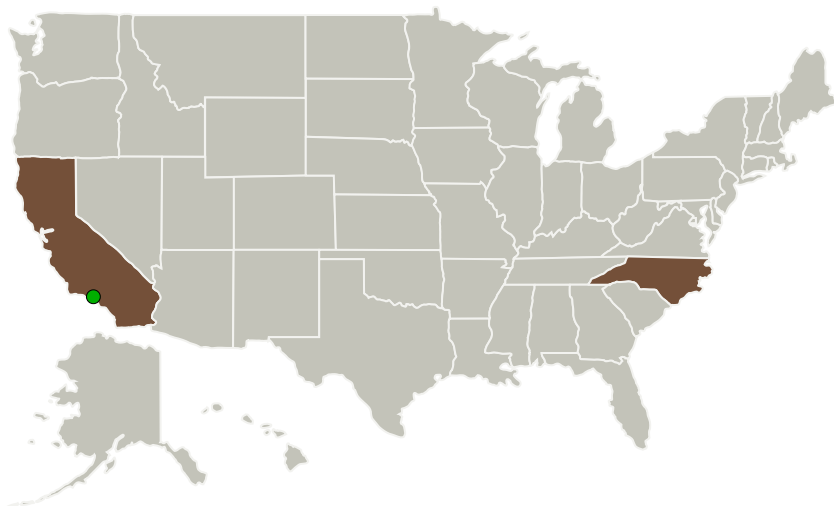
Completed Technology Project (2014 - 2014)



Project Introduction

The use of automated robotic tooling is required in a number of space missions. It is possible to have better tool control if the robotic arm could report loads experienced by the tooling. ATI Industrial Automation proposes to develop and prove technologies to be used in a low weight, low outgassing multi-axis force and torque transducer that can be used at cryogenic temperatures. The transducer will require strain gage excitation electrical power and output strain gage level voltage signals. These signals can be digitized and then mathematically transformed into values that represent the transducer's loads as forces in the X, Y, and Z axes and torques about the X, Y, and Z axes. The primary goal of this phase I proposal is to develop, produce, and characterize a proof of concept simplified transducer that can survive the harsh environments expected to be encountered on a Mars lander mission. The technical objectives are: 1. A transducer element capable of surviving temperatures from -135°C to $+125^{\circ}\text{C}$. 2. The transducer element in objective 1 with temperature compensation to minimize span and offset drift from -80°C to $+70^{\circ}\text{C}$. 3. The transducer element in objective 2 constructed so that it will sense properly in an atmospheric vacuum of $1\text{E-}5$ torr. 4. The transducer element in objective 3 made of low-outgassing materials that are compatible with an interplanetary sample-collecting mission. 5. The transducer element in objective 4 constructed so it can survive vibrations of a rocket launch. 6. The transducer element in objective 5 instrumented with redundant sets of strain gages. Two transducers will be built and tested: one with foil strain gages and one with silicon strain gages.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
ATI Industrial Automation, Inc.	Lead Organization	Industry	Apex, North Carolina
● Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	North Carolina

Project Transitions

**June 2014:** Project Start**December 2014:** Closed out**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/137784>)

Images

**Briefing Chart**

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(<https://techport.nasa.gov/image/128937>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

ATI Industrial Automation, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

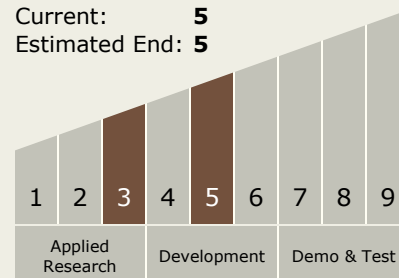
Carlos Torrez

Principal Investigator:

Dwayne Perry

Technology Maturity (TRL)

Start: 3
Current: 5
Estimated End: 5



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Technology Areas

Primary:

- TX04 Robotic Systems
 - └ TX04.1 Sensing and Perception
 - └ TX04.1.3 Onboard Mapping and Data Analysis

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System